EFFECT OF BRINE COMPOSITION ON WETTABILTY ALTERATION OF CARBONATE ROCKS IN THE PRESENCE OF POLAR COMPOUNDS

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Abstract

The impact of brine salinity and ion composition on oil recovery for carbonate reservoirs has been an area of research in recent years. This was motivated by the additional oil recovery that was recovered by low salinity and ionic modifications in sandstone and chalk reservoirs and to some extent in carbonate reservoirs. Wettability alteration to more water-wet conditions has been proposed as the mechanism leading to the additional oil recovery.

This study presents a fundamental experimental study to confirm wettability alteration and identify the potential determining ions in the injected brines leading to the alteration of wettability of calcite and carbonate rocks and to understand rock/fluids interactions in the presence of polar compounds in the oil. In this study, a systematic investigation was carried out by first establishing a well-defined initial wettability conditions using short and long chain carboxylic acids dissolved in toluene with a total acid number (TAN) of 2. This was followed by subjecting the calcite and carbonates rock samples to Arabian Gulf Seawater and diluted Arabian Gulf seawater having different ion compositions to identify their impacts on wettability alteration to more water-wet conditions. This study focuses on identifying the roles of SO4²-, Ca2+ and Mg2+ in the injected brines with different ratios on wettability alteration. The contact angle method was used to evaluate the wettability.

The results of this study showed that the long chain fatty acid (Stearic Acid) strongly adsorbs onto the calcite surface from the oil phase compared to the short chain (Heptanoic Acid) as confirmed by the measured contact angles. Twice dilution of Arabian Gulf seawater has been found to be a less efficient
EOR fluid for wettability alteration as compared to Arabian Gulf seawater. This was confirmed by the changes in the measured contact angles toward more water-wet for Heptanoic Acid /Calcite, Stearic Acid/Calcite and Stearic Acid/Carbonate systems treated with seawater and twice diluted Arabian Gulf seawater with different concentrations of SO4²⁻, Ca²⁺ and Mg²⁺ in it. Significant wettability alteration was observed for the twice diluted Arabian Gulf seawater with higher concentrations of SO4²⁻ and Mg²⁺. The results are supported by ionic analysis of the brines and mineralogical rock analysis using XRD and rock surface characterizations using SEM after treatment with the different brines used.